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REPORT OF AN ECUMENICAL CONSULTATION ON GLOBAL ENVIRONMENT, ECONOMIC GROWTH AND SOCIAL JUSTICE

Cardiff (Wales), September 3-8, 1972

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These papers are circulated for the information of participants in the ecumenical enquiry on "The Future of Man and Society in a World of Science-Based Technology". Comments are welcome.

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I

THE CARDIFF CONSULTATION ON GLOBAL ENVIRONMENT, ECONOMIC GROWTH AND SOCIAL JUSTICE

The papers and reports in this issue of *Anticipation* represent part of the preparatory material and the findings of the World Council of Churches Consultation on Environment, Economic Growth and Social Justice, held in Cardiff (Wales), September 3-8, 1972.

The Cardiff meeting was a successor to the 1971 conference in Nemi (Italy), where for the first time the problem of the carrying capacity of the global environment was broached and the Limits to Growth debate initiated by the Club of Rome was explored in an ecumenical context. At Cardiff we were able to go further in developing an ethical perspective from which to view the challenge of human environment, helped by the intense discussion stirred up by the U.N. Conference on the Human Environment in Stockholm, in June 1972.

The Cardiff Consultation was attended by about 50 persons drawn from a great range of disciplines, and was more representative than the Nemi meeting of African, Asian and Latin American thinking on this problem.

Implications of the Limits to Growth Debate

The discussion opened with a paper by Dr. E.F. Schumacher, for many years economic consultant to the British Coal Board. He was followed by Dr. E. Grebenik, who as Secretary of the International Union for the Scientific Study of Population, introduced the consideration of world population developments today.

It will not surprise readers of Prof. Schumacher's paper that it stirred a lively and sometimes heated debate, in which representatives from many different schools of throught participated.

Four concerns emerged from this preliminary discussion in plenary:

1. Technological and environmental developments make it necessary and possible to develop a new vision of the future of man and society; extrapolations from the present can be no guide in the search for alternatives to the ecological problems facing mankind today, and the new life styles which are needed. There is therefore a need for "Utopian" thinking in the search for such alternatives.

2. In moving from the present to the future (from here to there), what patterns of change should guide us and what criteria for desirable change might be developed ?

3. It is essential to resolve the debate about "finite resources" in view of its importance for determining a course of action for the future . Some scientists have argued that we shall relatively soon reach the limits of finite resources; others have argued that forecasts of imminent resources exhaustion are greatly exaggerated and that resource availability is difficult to forecast. They believe that Technological breakthroughs are possible which will greatly alter the so-called "predicament of mankind".

4. The doubling of the world's population between 1970 and 2000, poses economic, social and ethical issues of enormous proportions to governments and peoples. Can the churches begin to develop a population ethic corresponding to the dimensions of the rapidly changing world population situation, and to the methods of population control being developed or practised in different countries ?

This led to the continuation of the discussion in four working groups:

I.	Utopian Vision of the Future	(chaired by Dr. Margaret Mead, U.S.A.)
II.	Patterns of Change and the Quality of Life	(chaired by Dr. C.T. Kurien, India)
III.	Towards an Ethic of Natural Resource Use	(chaired by Prof. Charles Birch, Australia)
IV.	Population Control and the Quality of Life	(chaired by Dr. John Karefa-Smart, Sierra Leone)

The reports of Working Groups I, II and III are included herewith. Group IV (Population Control) submitted a report which is dynamic, far reaching and . . . incomplete. Since a report on this topic must be submitted to the World Council's Central Committee meeting in Helsinki in 1973, we have decided to make it the basis of further study and it will therefore be circulated for additional comment especially by persons working on government population policies, before publication. It is likely that it will be published in an issue of *Anticipation* early in 1973.

The reports reflect the uncertainty, as well as the areas of understanding and agreement reached by scientists and technologists representing many different disciplines and countries and seeking to view their problems in Christian perspective. Taken together they show a new turn in ecumenical thinking, based on the desire to reexamine old assumptions about the goals of man and society and about the quality of life.

Paul Abrecht

II – A

THE UTOPIAN VISION : IN SEARCH OF ALTERNATIVES

Human beings can choose and change. They are not condemned to the endless repetition of past patterns. We believe the only legitimate way to approach the challenge of the future is first to ask what kind of world society we want and then to ask about the constraints we must consider in moving towards that future. These constraints – including physical and cultural ones – will inevitably qualify our actions, but the goal itself must not be dictated by present assessments of what is possible. To define the future merely by extrapolating current trends and options is to surrender to the tyranny of the present. Sketching Utopian visions and alternative images of the future is a realistic and liberating human activity. It is one way by which people can begin to discuss the social values they believe important and to question accepted criteria for social decision-making.

The Christian faith and most of the other widespread religious and humanistic traditions of mankind provide us with first premises. They portray all mankind as one brotherhood and teach us that a man's love of his fellowman is the clearest expression of his love for God. They also warn us that the piling up of earthly possessions cuts us off from God and our neighbour and thus gravely endangers the human spirit. We begin therefore by affirming the primacy of God and his will, from which is derived the essential oneness of the entire human species and the incalculable value of each person without regard to sex and age, colour, competence or any other secondary characteristics. God has created mankind within a wider world, so we see the value of human life as part of the network of nature, and not in opposition to it. Indeed, we see mankind as the most powerful, most dangerous of all the species. It can destroy itself and the planet; to care for itself and other species mankind must protect and cultivate the fragile environment within which it lives. Mankind therefore has the greatest responsibility for the entire biosphere.

We envision a world community in which war is only a memory and in which we respect the delicacy of the biosphere, honour the rightful claim of every child and adult on the world's goods, and promote the participation of all persons in the making of social decisions.[1] We insist that the future occupancy of earth by human beings requires careful and long-term planning, but we reject the use of futuristic extrapolations to undercut efforts to meet pressing and urgent needs of those now alive for food, housing and other essentials.

We affirm the desirability of a world in which each person has access to the resources of the world society commensurate with his basic needs and aspirations for a fuller, more human life, but we believe that an even more urgent need for every person is to provide now those *minimum* requirements that make life possible. Still, the movement from a world of minimum standards to a world of equal or comparable opportunity is a pressing ultimate goal. Large disparities in wealth and power are therefore undesirable not only in a needy world also in one where basic needs are met.

* * *

The following are some criteria for a shared and desirable future, derived from the goals we have stated and which apply to contemporary conditions and present scientific knowledge:

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[1] This is not a suggestion that day old infants should vote or the mentally defective direct a department of physics, but we prefer to make the statement flatly because the danger of hedging if a word like *appropriate* preceded the word *participation* is greater.

1. Diversity should be sought and fostered in every field, cultural style, technological adaptation, scale, political systems, etc. as a protection for the whole living and as a source of enrichment of human life. Just as we cannot afford to lose forever one species of grain, or one living thing – because we may need them later in the establishment or re-establishment of balance or harmony in the life support system – so also we cannot afford to lose a single culture, no matter how small, primitive or experimental, that has shown itself to be viable, for it may contain some unique and priceless characteristics, embodied in its ongoing life which once lost can never be retrieved.

2. Scale of organization (size of market technology, community, enterprise, etc.) is of the greatest importance and should be considered very carefully, in respect to: participation in social decision-manking, access to technical processes, increase in meaningfulness to the individual participant, increase in diversity, protection of the environment (endangered by large-scale, globally distributed technologies), increase in the number of options that can be given to individuals and changing social systems, and the possibility of establishing many interrelated but diverse educational systems to replace the present trend towards uniform, single ladder systems which recognize and reward only a small sector of human abilities.

3. Needed Institutions[1]

Institutions are needed which will serve as organs of society in the conscious direction of the future by,

- Monitoring the course of present technological and socio-political forms,
- assaying their impact on humanity and the whole biosphere,
- foreseeing the possibility of future development,
- providing for social controls of the direction and application of scientific research and technology – e.g. halting all research and development specifically oriented to warfare,
- actively pursue research directed towards new and better technological solutions.

Production and Technology for the Future

Production should be guided by human needs and not by personal pursuit of profit or power.

In the present state of world-wide development the selection of capital intensive or labour intensive technologies should be determined by the state of development and situation of each country or society and its main objective should be to reach a state where each individual has a share according to his ability in the productive process and its products.

The organization of the productive system should tend, as much as possible, to rely on the creativity of the individual worker, so as to diminish the dichotomy between personal realization and contribution to global social needs.

Each community or society should have full access to the accumulated scientific and technological knowledge of mankind in order to select, adapt or create the technologies which best respond to its own necessities or cultural patterns.

Besides satisfying the basic necessities of life, which we think are common to all human beings, the society should foster cultural diversity.

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[1] The group recognizes the importance of the question of power, but did not go into this beyond the discussion of scale and the importance of social participation.

As technologies are an integral part of culture, each country or society has to be encouraged and helped to create its own scientific and technological capacity. This does not mean creating separate scientific systems, but giving every country a real opportunity to select the technologies best adapted to its cultural patterns.

In the planning of technologies suitable for our future society, it is irresponsible to assume that resources are inexhaustible, although present estimates of the earth's resources may be questionable. The search for alternatives to currently used natural resources and energy production is essential.

However, such a search must be guided by considerations not necessarily present in the motivation of much current scientific and technological research and development.

The search for technological alternatives must be guided by four considerations:

1. Who benefits by the alternative ?
2. Who has access to the alternative (that is, not to its products as much as to the production of the alternative itself) ?
3. Will the research and/or production of any alternative seriously reduce the estimated time scale for the availability of any important resource (including energy); or will any by-products of the research or development overtax the absorptive capacity of the earth's ecological system ?
4. The production of alternatives must be inspired by a goal of increasing diversity and decreasing reliance upon a single system (this point is not just "ecological"; single large-scale centralized and undiversified systems lend themselves too easily to political control of the sort we have described as undesirable).

These four points reflect our concern over the question of risks involved in large-scale technology, although we recognize that there is not a one-to-one relationship between scale and the likelihood of accidents. We agree that it is crucial to put increased emphasis on the likelihood of accidents, such as leaks in nuclear power plants, and their implication. In this connection the following points indicate common concerns important to our Utopian perspectives:

1. We see an important distinction between an *increasing number of small undesirable accidents* or side effects (which may be "acceptable" in terms of the benefits derived in comparison to the risks, especially in the light of expected remedial technology) and a *small number of increasingly severe accidents* which may destroy the fabric of society (e.g. the trend to large oil tankers is beneficial in terms of efficiency and may reduce the likelihood of an accident; however, an accident, should it occur, could conceivably produce an eco-disaster).

2. A number of small accidents or side-effects (which may be "acceptable" as in 1.) may, added together, produce a total effect larger than the sum of the individual effects.

3. Precaution or the prevention of accidents implies predictability. We are not convinced that this is always possible, in terms of both magnitude and form (e.g. the DDT and PCB build-up in the sea). Historical analysis of the origins of the current crisis does not lead us to optimism on this point.

* * *

Forms of social organization should be sought which ensure congruence between loyalties to groups, in ascending order: family, community, regional tribe, country or nation, the world; and loyalties to religious, linguistic, ideological or political groups. At the present time some of these are emphasized at the expense of others, e.g. family and nation at the expense of community and world, or tribe or extended family at the expense of the family or the nation. When the main conflicts were over land, these conflicting loyalties were harder to overcome, than when air and oceans, which can only be shared and never owned or protected by any group smaller than the whole of mankind, became scarce and the most fragile and valuable possession. Forms of social organizations which promote hatred, exclusiveness and disproportionate wealth or power should be de-emphasized. In the building of loyalties, in the home, the community, the nation, the church, the political party, the craft or profession, emphasis should be placed on the shared future, beginning now, with its tasks, dangers and opportunities, and not upon those aspects of the past which keep alive old hatreds and promote guilt or grievance over past injustices and inequalities, conquest and exploitation.

II – B

PATTERNS OF CHANGE AND THE QUALITY OF LIFE

Our vision of the good future is dynamic rather than static. The concept of growth in all its fullness is one that encompasses far more than the narrow increase of certain material goods. Whether or not there is any immediate threat of reaching the limits of some finite resources, the option before us is not between growth and no-growth. Our task is not even merely to define an optimum rate of growth. It is to define, within each context, the appropriate patterns of production, taking into account the most pressing social needs and the most pertinent resource constraints.

In trying to develop some criteria by which one might judge and guide socio-economic change, two types of criticism of economic growth may be considered. The first is that economic growth as it has been experienced in many parts of the world has not effectively helped the poor (e.g. India over the past 25 years); has led to the production of the wrong goods (e.g. too many motor-cars for the rich and not enough houses for the poor); has caused much alienation of people who feel like anonymous cogs; and has contributed to pollution and the threat of a silent spring.

The first set of criticisms has, in recent years, led economists and others to a greater awareness of the fact that the whole concept of economic growth is inadequate and needs to be redefined in terms much broader than a narrow measurement of the Gross National Product. Moreover, even if it is desirable (which is disputable) to measure growth in terms of the production of material goods alone, such a measurement will be misleading unless it includes also an evaluation of the nature of such goods. The production of armaments may increase GNP but it can hardly be said to improve human welfare, particularly if it is at the expense of, say, improved educational opportunities for the poor.

Given these criticisms it is necessary to try and develop some set of criteria by which the patterns of change taking place within society may be assessed and modified. Such a set of criteria might include the following:

1. *How much social stress or disruption does it cause ?* Whilst social stress in itself is clearly not good, too often it has been over-valued as an argument against social change. For such stress is not caused only by change: it exists already within the status quo, in the form of structural violence of which men are becoming increasingly aware. In many cases the new social stress brought about by change is not as severe as that already existing.

2. *Does it narrow the gap, both within and between, nations* with regard to

   a) Income and material well-being ?
   b) Education, understanding and communication ?
   c) Power ?

On the basis of the consistent preference which the Christian owes to the needs of the poor, the dispossessed, and the powerless, it is vital that the distribution of wealth, information and power within particular societies and between nations be more equitably ordered. For all men there are numerous imperatives of world responsibility making it necessary for them to work for such redistribution. These imperatives includes:

(i) Prudence, or the threat of breakdown. If some nations continue to become richer very much faster than others whose population density becomes ever greater, then there is real danger of some catastrophe whether by famine, by nuclear war, or by the complete breakdown of social organization in a particular area. In the face of these dangers, Christians are surely called by the God of the Prophets to act perceptively and creatively.

(ii) Trading responsibility. Those who, for example, drink cocoa in Britain have some obligation to ensure that those producing the cocoa in Ghana have sufficient to live on and are not battered by enormous fluctuations in the price of cocoa beans. There is also a historical dimension to this imperative arising out of the old imperial connection.

(iii) Imbalanced impact of technology. The heavily industrialized countries have a direct responsibility for the well-being of the Third World arising out of the historical links between them whereby technological breakthroughs in the West were transferred to other countries without a full understanding of the impact of such piece-meal transfer on the recipient societies.

(iv) Theological. For Christians[1] there is a fourth imperative more important than any of the first three: it is one which stems from the biblical vision of the solidarity of mankind. The Church, a symbol of the unity of mankind, must surely take the lead in proclaiming to all men their mutual responsibility whether or not they are linked by trade.

Within the context of problems raised by the distribution of power, it is increasingly obvious that the role of large very powerful, multi-national corporations needs special consideration.[2]

3. *Does it conserve resources ?*

In view of our obligation to future generations, and considering the lead-time required for technological innovations, the use of *non*-renewable resources should be planned to last as far into the future as men are likely to have to depend on them. Goods should accordingly be made to last as long as possible, not to become quickly obsolete. God stewardship obliges us not to be wasteful of the Creator's gifts to all generations of mankind. The use of renewable resources must not exceed their capacity to regenerate themselves. The self-cleansing capacity of the earth must not be over-taxed to the point of breakdown. Aesthetic considerations – the appearance of air and water, the face of the landscape and the pattern of human settlement – should also be given their due.

4. *Does it create useful and satisfying work and leisure ?*

Where underemployment exists or threatens, social and economic changes should create, rather than eliminate, jobs. Jobs, in turn, should satisfy the human need to perform socially useful work, to participate in decisions affecting one's own employment, and to labour in congenial surroundings. If, at an advanced stage of industrial development, when the economy has provided for life's basic necessities, a society should be able to afford increased leisure, appropriate changes would be those which provide opportunities for the creative use of this leisure.

5. *Does it increase self-reliance without desirable interdependence in today's world ?*

Tension always seems to exist between the need for independence and the enrichment of interdependence. An individual, a group or a nation should be able to safeguard its own integrity, to enter contracts without begging, to maintain and enhance its identity and strength in its dealings with others *provided* it does not give in to pride and selfishness, nor seek to promote its own advantage to the impoverishment of others. Trade among nations, for example, must avoid excessive protectionism and isolationism on the one hand, and dominance or exploitation on the other.

6. *Is the burden of risk inherent in change and development shared equitably ?*

The weaker members of an economy – e.g. those last to be hired and first to be fired and those living on pensions – should be protected against economic fluctuations and dislocations.

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[1] We do not of course wish to imply that the vision of the solidarity of mankind is confined only to Christians. But we do wish to drive home to Christians that such a vision is part of their inheritance.

[2] See, for example, the forthcoming OECD study on the role of multi-national corporations in the Third World.

Economic and technological changes should benefit the largest number possible and should not be reserved for the profit of a few, particularly if this is at the expense of others.

Industries which damage the environment should correct this fault and not simply shift their operations to another locality which would tolerate pollution for the sake of new employment. Groups and nations which use disproportionate amounts of finite resources should alter their practices so as not to punish their supplies either now or in the long run.

Some changes will qualify as good in terms of some of these criteria and as bad in terms of others. Not all social change will pass all these tests. Hence costs will have to be weighed against benefits in the widest sense of these terms. Clarification of a set of criteria should help us however to become more aware of, and sensitive to, the ambiguities inherent in the whole process of change.

Two examples of the application of these criteria are given below.

A) The first concerns transport in developed industrial nations. There the use of private motor-cars has a number of positive effects. It enhances individual freedom, makes possible some kinds of communication which would otherwise take too much time, and in sparsely populated (agricultural or holiday) areas may be the most efficient form of transport. On the other hand private motor-cars involve an extravagant use of non-renewable resources. In cities they are far less efficient than buses or trains, and create health hazards by polluting the air. Moreover, their existence has the effect of worsening public transport, to the particular detriment of those without motor-cars.

In a larger sense, the devotion of natural and financial resources to private automobile transportation on such a massive scale inhibits the development of services which are often sorely lacking even in nations commonly called "developed". Were a substantial reduction in the ownership and use of private motor-cars to be achieved then the distribution of health services, recreational facilities, educational opportunities and adequate housing, as well as better public transport might be more readily achieved. At the same time, such a redistribution in the type of goods and services would have enormous effects upon the structure of employment. And it would set in train a whole chain of social changes whose impacts would have to be assessed with great care before a final policy decision on the future of the motor-car in a particular society could be reached.

B) The second example concerns the introduction of modern technology and marketing methods into developing countries. The importation of consumer goods – cosmetics, ball-point pens – from an industrial nation may satisfy felt desires in more affluent sections of the importing nation and may give employment to local distributors, and yet be disproportionate in terms of more basic needs. Moreover it may ultimately result in a net *outflow* of wealth. The substitution of modern productive methods for traditional forms of supply – large herds and efficient dairy plants instead of thousands of peasants with one or two cows each – may increase total production, make more goods and better health available to more people at a lower price, and yet deprive vast numbers of people of their principle means of livelihood. Similarly the introduction of synthetic fibres may enrich consumer choice, provide more durable and useful clothing, and create new forms of employment, and yet destroy the local wool industry of small-scale producers and the village economy which it supports. It may also cause the ecological damage to which synthetic products are particularly prone.

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The new technical methods may enrich the few who know how to manage advanced technology and marketing without providing appreciable benefit to the many. Such change might also be to the detriment of those who lose some real independence and become instead hired hands in an impersonal process. The shift of labour intensive industry from industrial countries to the Third World may lower unit costs of production and provide needed support to a weak economy, and yet have the effect of reducing to unemployment and poverty many vulnerable workers of the so-called "developed" country. If one developing country sells the products of its new industry to another developing country, the first will benefit but the second might not.

In all cases trade should enable the world to realize the natural advantages of the uneven distribution of economic resources, human and material. Yet, in practice, trade frequently exacerbates existing injustices and the maldistribution of power. There is no simple and clear way out of the labyrinth. The effects of given changes, in all their ambiguity, will have to be weighed and measured by such standards as are here suggested before their real desirability can be adequately assessed.

II – C

TOWARDS AN ETHIC OF NATURAL RESOURCE USE

1. Defining Resource Limitations

Any level of *use,* not just increasing use, if sustained long enough ultimately exhausts conventional non-renewable resources. Two essentially different alternatives exist if we desire long-run occupancy of the earth. The first alternative is to organize human activity in such a way that it relies completely on the natural or biological systems based on current energy flow and materials recycling. The second alternative is to push back the physical constraints limiting human activity through continuous application of sophisticated technology. The second approach, if implemented successfully, and without serious side effects, increases the carrying capacity of the earth, thereby making possible a larger population at a higher material standard of living than the "natural" approach. The technological alternative is only feasible in a society that is rich enough and suffiicently well organized to generate scientific advances.

Human activity at any point in time has to be compatible with the following physical constraints:

(i) a finite land/sea/air
(ii) a finite supply of non-renewable resources – minerals, fossil fuels – only a small fraction of which can be used per year it we want to sustain usage for a long time
(iii) a finite annual production of renewable resources – wood, crops, animals
(iv) an ecosystem which can only absorb a finite amount of degradable pollution per year
(v) an ecosystem which can only absorb a finite amount of heat per year, thus limiting the possible energy use.

All these physical constraints can conceivably be pushed back by technological innovations and thus their positions may vary through time. We are faced with the situation that because of lack of knowledge about the current position of the constraints and because of the impossibility of predicting with certainty what constraint-releasing technologies will appear in the future, the time at which we shall reach the limits of certain of these resources cannot be precisely defined. For example, the extraction of aluminium from clay would completely alter the time-scale for depletion of that metal.

The known reserves of many minerals essential for existing types of technology and the known reserves of most fossil fuels will be exhausted within the next few hundred years. Some will be exhausted quite soon, e.g. mercury, copper, natural gas. However reserves are a function of production and consumption in the sense that fuller exploration takes place when the demands of production and consumption increase and shortages ensue. It does not follow that new reserves will always be found. Some mining experts estimate that the stocks of exploitable reserves under present technological conditions could be multiplied by a factor of the order of fifty. Even so, the time will come when these reserves will also be exhausted. This time is brought much closer if exponential rates of use continue.

Insistence on continued use after the depletion of concentrated ore deposit will force us to depend upon the use of low grade ores and basic rocks. Extraction from these sources would depend on technologies not yet in use and which are only partially developed. The practicability of using these technologies is another matter.

In spite of this uncertainty about the position of resource constraints there is general consensus that we have entered the transitional period during which decisions must be taken and implemented concerning a major redirection of our technology, particularly that relating to resource consumption. The length of the transition

period is uncertain, but the main change of direction ought to be accomplished within the next hundred years. Due to the inevitable delays in technological and social adaptation, the initiation of this process should be begun now.

2. Comparing the Risks of Alternative Approaches

We are consequently faced with the following question – since we do not know the limits of our physical resources, should we generally act as though the currently known reserves were the only ones available ?

Our argument for such an approach is that it will minimize the risk of resources shortage to future generations; as such it expresses a concern for unborn children and neighbours of the future.

This does not mean a halt in technological innovations. It does mean that we should not go ahead wasting resources today assuming that future technology will satisfy our descendant's needs. Rather we should first develop the constraint-releasing technology, and test it to be reasonably sure that it is free from serious side effects. It is only after such a breakthrough comes that society can expand with confidence in that direction.

It may be argued that the breakthrough will not occur until the correct level of incentive for research and development in these areas is provided. Basically this occurs because of our lack of emphasis on the future effects of current activities. The planning period for industrial societies should be extended forward to encompass this difficulty. A long planning period also reduces risk because it gives us more time to devise solutions to future problems. The scope of this concern falls outside the region of private enterprise and even in some cases of national government.

The above risk argument provides an ethical basis for a new approach to technological innovation. This approach must include the following:

- Monitoring of technological development for continuing evaluation by politicians and the public at large. This should be done on national levels and at the international level when appropriate (e.g. the supersonic transport);
- environmental and social impact assessment of new technology before it is introduced on a large scale;
- a conservation ethic that would achieve a more efficient and equitable use of non-renewable resources;
- a public which is well informed on these issues to provide the necessary political pressure for funding and for the development of technology which reflects the values of the community.

3. Assessing the Social Consequences

One way of handling the resource problem is to use technological innovation and a long planning horizon to minimize the risk of resource shortage. However, in many instances it seems that a solution that involves less risk than the implementation of new technologies requires a change in social priorities. Value changes of this type will also be preferred to technological solutions in the cases where the new technology has undesirable social effects, like putting more power in fewer hands, reducing meaningful employment, making life more sterile, decreasing the social interaction between people or decreasing the diversity and hence stability of the society.

For example it can be argued that a more desirable response to the noise and pollution problems arising from the private motor-car would involve a value change; namely reduction in the use of cars rather than the seemingly technological response of making the car less noisy and polluting.

On the other hand neglecting to develop new technologies at appropriate points of time may for ever reduce the options for humanity and hence also be termed risky. An example is the need to develop and to perfect an alternative power source before the exhaustion of fossil fuels.

4. From the Viewpoint of the Less-Developed Countries

Many developing countries have been and remain sources of raw materials to the former colonial powers and to the contemporary industrialized countries. Basically, easily accessible resources and low labour costs have made this profitable for the industrialized countries. A consequence of this has been the creation of new national elites in the developing countries which emulate Western affluence without concern for the majority of their people who are poor. These elites show little or no concern for,

(i) depletion and waste of the nation's resources
(ii) increased social inequality within the country
(iii) the damaging effects of imitation of western consumer attitudes which are irrelevant to the real needs of the people
(iv) the lack of a technology addressed to the needs and economic possibilites of the masses.

In the light of the above the Third World might have to turn inwards to in order to develop their own quality of life and a technology suitable to their own cultural, human and natural environment.

It is morally imperative that the industrialised countries stand ready to share in the advancement of indigenous solutions as requested, and to minimize their technological frivolity and overproduction resulting from western consumer attitudes. Besides being a pragmatic response to a real situation, such an attitude of technological restraint reflects the basic Christian attitude of the stewarship of material creation.

III

IMPLICATIONS OF THE LIMITS TO GROWTH DEBATE SMALL IS BEAUTIFUL

E.F. Schumacher

What, it must be asked, is "Growth" in this context ? It is impossible to say, because Growth is a purely quantitative concept without any qualitative determination.

As everything corporal is, as it were, composed of quantity and quality, purely quantitative concepts do not touch reality at any point.

It is not possible to say that Growth is either good or bad, either desirable or undesirable, either possible or impossible. Equally, it is not possible to talk about Limits to Growth (except, as concerns the corporal world, in an abstract and ultimate sense, e.g. "infinite growth in a finite framework is impossible") or to talk about the desirability of Non-Growth. Any debate conducted in purely quantitative terms is nothing but a battle of words without meaning.

Of course, it will be said: "When we discuss Growth, Limits to Growth, or Non-Growth, we are merely using a kind of shorthand; we know what we mean in qualitative terms. These are implicit." But even if this were generally true, it would be a highly unsatisfactory state of affairs – to allow the higher factor – quality – to remain implicit, while the lower factor – quantity – is made explicit and, in fact, treated as decisive.

The "Predicament of Mankind" is directly due to the "Reign of Quantity" – materialism, GNP worship, treating money and acquisition as ends in themselves, etc. – in other words, to treating quantity as primary and the qualitative determination implicity as self-understood, i.e. not worth bothering about. A purely quantitative treatment of this predicament is therefore yet another symptom of the disease and totally incapable of leading to a cure. To substitute the concept of Non-Growth for the concept of Growth is to replace one emptiness with another.

All the same, it can be argued that the Club of Rome study is the kind of symptom which may arouse enough attention so that people become interested in curing the disease which, hitherto, they had studiously interpreted as a condition of excellent health.

It must, however, be quite clearly understood that the attempt to remove symptoms is not equivalent to an attempt to cure the disease; in other words, that the prescriptions given in the Club of Rome study are worthless.

What are these prescriptions ? They are marked by total perplexity and helplessness.

p. 173 : ... we have now arrived at a minimum set of requirements... they are:

1. The capital plant and the population are constant in size. The birth-rate and the capital investment rate equal the depreciation rate.

2. All input and output rates... are kept to a minimum.

3. The levels of capital and population and the ratio of the two are set in accordance with the values of the society.

Now, all this, I suggest, is the most appalling nonsense, to the extent that it has any meaning at all. Why is it nonsense ? Because none of the concepts used have any real meaning. They are the illegitimate children of a speculative imagination that has lost contact with reality. Capital plant constant in size ? A dam built to abolish water erosion in Lesotho may be built only if somebody in England gives up his second car ? The farmer in the Transkei may acquire a plough only if your wife goes without a sewing machine ? "Of course we don't mean that ! " Well, what on earth do we mean ? And why don't we say what we mean ? The world population constant in size ? Are there no underpopulated regions in the world – countries like Zambia, where nothing can happen without a greater density of population ?

I don't wish to waste your time by dwelling on the truly gigantic nonsensicality of these propositions. They don't point the way to action. They do not identify the disease and therefore cannot point to the possibility of a cure. They are, themselves, a symptom of the disease, because, product of a mindless computer, they are purely quantitative constructs, without any relation to reality.

Let us start from first principles. Man, a child of God, is *designed* for growth. He is endowed with great gifts which he is called upon to use – see the parable of the talents. Being a composite of body and soul, he is called upon to look after his body, which is the dwelling of his soul and, in fact, the temple of God.

This Conference is under the auspices of the World Council of Churches, and we are entitled, therefore, to discuss the fundamental questions of man's existence on Earth – how is man to use the splendid gifts with which he has been endowed ? The answer was given – in its most concise form, I believe – by one of Christendom's greatest saints and organizers, as follows:

> Man was created to praise, reverence, and severe God our Lord, and by this means to save his soul; and the other things on the face of the earth were created for man's sake, and in order to aid him in the prosecution of the end for which he was created.

Whence it follows, that man ought to make use of them just so far as they help him to attain his end, and that he ought to withdraw himself from them just so far as they hinder him.

As Gandhi said, there is enough for everybody's need but not for everybody's greed.

Now, I know of course, having been around a good while, that there are many who think that saints are there to be admired but on no account to be taken seriously. To me, I must confess, they are the most practical people that have ever been, and as an economist, I cannot help taking them seriously. I believe – not without reason – that the statement I have just read – just so far as they help him and just so far as they hinder him – is the crux of everything we have come together here to discuss. I also believe that Gandhi, another very practical saint, knew what he was talking about.

In other words, it is impossible to talk about "The Implications of the Limits of Growth Debate" without considering what man was created for. There is no solution to the problems presented by what the Club of Rome calls the Predicament of Mankind, unless we remember what man was created for: because our Earth was also created precisely to serve man just so far as he needs it to do his job, but not just so far as to enable him to worship the false gods of limitless materialism.

During the recent past, it seems to me, the churches had no time for considerations such as these. They wanted to be "with it" and saw their main function in preaching to the working class that they should be good boys and help to produce a bigger cake – then their own slice would be bigger too. I have never been able to see the value of this approach.

However this may be, aimless Growth along the lines of the past is now being called into question. So where do we go from here ?

It is perfectly obvious that there is no means whatsoever at our disposal to stop either the Growth of world capital or of world population. What we can do, however, is to fight the growth of what is unsound and promote the growth of what is sound. The arithmetical balance between the two is of no concern whatever.

To know what is unsound in current patterns of living – growth or no growth – we must divert our attention first of all to the rich countries of which the U.S.A. is the leading example. Here you have a society, containing 5,6 % of the world's population, which uses 40 % of the world's primary raw materials. A useful table is given on pages 56-60 of *The Limits to Growth.* Column 10 shows U.S. consumption as % of World Total. The crucial materials are fossil fuels

Coal 44 %
Natural Gas 63 %
Petroleum 33 % – all non-renewable.

It is obvious that the world cannot afford the U.S.A. Nor can it afford Western Europe or Japan.

In fact, we might come to the conclusion that the earth cannot afford the "Modern World". It requires too much and accomplishes too little. It is too uneconomic. Think of it: one American drawing on resources that would sustain 50 Indians !

The earth cannot afford, say, 15% of its inhabitants – the rich who are using all the marvellous achievements of science and technology – to indulge in a crude, materialist way of life which ravages the earth. The poor don't do much damage; the modest people don't do much damage. Virtually all the damage is done by, say, 15%.

It is obvious, therefore, that the Club of Rome exercise, which lumps all people together into a "World population" and also lumps all production and all consumption together, as if everything were much of a muchness, far from clarifying the tense situation, obscures it. *The problem passengers on Spaceship earth are the first-class passengers and no one else.*

They are now calling a halt to "Growth", and of course, this sounds ominous and hollow in the ears of the other 85% who still travel very uncomfortably. (Even the disclaimer, made in the Commentary on p. 191, does not help. Having recommended the cessation of Growth, the commentators "recognize that world equilibrium can become a reality only if the lot of the so-called developing countries is substantially improved"; but they fail to tell us how you can fit a quart into a pint pot.)

How can we escape from the perplexity and helplessness which characterize the Limits to Growth report ? First, we need a proper diagnosis. The modern world has been, and continues to be, shaped by modern technology. Now, from the point of view of survival, modern technology is monstrously inefficient. It lives on capital, not on income, i.e. on non-renewable materials – fossil fuels, on the "tolerance margins of Nature" – hence the ecological crisis, and also on the "human substance" – hence the universal protest, unrest, violence, resort to crime, drugs, mental breakdowns, and so forth.

It appears that our predicaments are not due to our failures but to our successes. Yet it cannot have been wrong to develop Science and to use science to develop technology. Somehow, somewhere our development of science and technology must have taken a wrong turning. Perhaps I might describe it this way:

If an ancestor of long ago visited us today, what would he be more astonished at

- the skill of our dentists or the rottenness of our teeth ?
- the speed of our transport or the length of time and discomfort incurred in travelling to and from work?
- the progress of medicine or the overcrowding of our hospitals?
- our ability to land man on the moon or our inability to find work for the workless?
- our drives for productivity by means of mechanization, rationalization, automation or the staggering inefficiency of the system as a whole?

– the purposefulness of our technological strivings or the aimlessness of our overall policies?

And so forth.

He would certainly feel utterly puzzled and confused. We say we need capital to create jobs, and at the same time use capital primarily to save jobs. We claim that never before in history have so many people been so well educated, but they cannot do anything for themselves, having become utterly dependent on vast and vastly expensive machines and organizations.

We say that the earth is overpopulated, but insist on emptying the countryside and all crowding together in monster cities many of which have already become quite unmanageable. And so forth.

This sagacious observer, with no axe to grind, might come to the conclusion that all these extraordinary contradictions are due to the fact that we have developed a habit of thinking of goods and profit first and of people – if at all – afterwards. Production comes first, with no holds barred, and then, if it is found to cause human or environmental damage, we try to cope with social and other consequences. But how could one cope with the consequences? The damage has been done ! We get someone to pay for it, – if we or he can find the money . The trouble is, however, that money cannot compensate; it cannot undo the damage. Compensation paid to an accident victim does not undo the accident, just as the skill of our dentists cannot compensate us for the rottenness of our teeth. And then, no matter how rich we become, we always find ourselves short of money...

Our observer may come to some further conclusions. He may say: All the remedies you now propose deal only with "consequences" and are not remedies at all.

a. You want to cut out waste; excellent! But the main wastefulness lies in your pattern of production and your pattern of living, not in the often silly way in which you waste what you have produced.

b. You want to "recycle" materials; but the one material on which everything depends – energy – cannot be recycled; ever more energy will be required to do the recycling job itself.

c. You want to fight pollution – after it has happened, by using more science and technology to this end. But this is an attempt to get Beelzebub to drive out the devil.

d. You want to reduce population, but if one person living "American-style" does fifty times as much damage to resources and environment as one person living "Indian-style" how can you ensure that smaller numbers will not do even greater damage by switching from "Indian-style" to "American-style"?

Do all these things, he might say, if you can, but do not for a moment believe that they would solve your problems.

Instead of losing patience with this awkward observer, we might ask him for his view of the problem. I do not know what he would reply and shall now give you my own reply for what it is worth.

The trouble arises, of courses, – as I have said already – from our basic, metaphysical attitude to life – the Reign of Quantity, Materialism, not knowing where to stop in our pursuit of material satisfaction, disregard of non-material values, and so forth. But I do not propose to remain at this level of argument.

These metaphysical errors have, as it were, incarnated themselves in modern technology which has some very clear and destructive features.

a. It has become too big
b. it has become too complex, and
c. it has become too violent.

These three features, taken together, make it incompatible with

a. human nature
b. the rest of living nature, and
c. the resource endowment of the world.

If we want to help ourselves, we must work to use the fullness of our modern knowledge, consciously and with the utmost determination to create – or recreate – a technology which is

a. small, i.e. adapted to the human scale
b. simple – so that we do not have to become too specialized to be wise, and
c. non-violent, in the sense of working with Nature instead of bludgeoning her all the time.

All material things – incl. organizations – must have their proper, *human,* scale, or they become anti-human. This has been known since Genesis. Aristotle knew it and so did Dr. Marx. The best bit in the Club of Rome study is a quotation from Aristotle (p. 156):

> To the size of states there is a limit, as there is to other things, plants, animals, implements; for none of those retain their natural power when they are too large or too small; but they either wholly lose their nature or are spoiled.

In protection, small units can find their resources within a short radius and also their markets. There is no need for monster transport.

Small is beautiful; it is also simple and non-violent. Intelligent small-scale technology can use income-energy instead of fossil fuels; it is humanly right because the human mind can encompass it; it is socially right because it favours the well-being of small people, not only those already rich and powerful.

There can be no genuine *development* without small-scale technology, nor can there be a correction of over-development without it.

But size is not all. Keep things simple or, rather, use the fullness of modern knowledge to recapture simplicity. Man's needs are essentially *simple,* only his extravagances and frivolities are complex. *Complexity* – any fool can make things complicated; it takes a touch of genius to make them simple.

The complex

– is capital-intensive and expensive
– is produced by giantism and leads to it
– excludes the majority of people
– demands, as I said before, people too specialized to be wise;

and, assuredly, we are now far too clever to be able to survive without wisdom.

Wisdom is subtle, but at the same time, simple as a little child.

We now possess such superlative scientific knowledge and technical ability that we can make things simple again.

Thirdly: non-violence.

Let us use our great knowledge to find non-violent solutions to our many problems.

Biological processes are non-violent compared with mechanical or chemical processes: e.g. Energy requirements to create artificial polymers in factories, which Nature creates with sunlight.

Income energy is non-violent; to use it presupposes smallness.
Organic gardening and farming is non-violent.
Prevention is non-violent compared with cure.
Pollution is the result of violence, almost a measure of it.

The Club of Rome study accepts nuclear energy as a breakthrough extending the 'Limits to Growth", p. 131: "The technology of controlled nuclear fission has already lifted (?) the impending limit of fossil fuel reserves." The authors give statistics about the expected accumulation of radioactive wastes – but they are evidently so wedded to pure quantity that they cannot appreciate the awesome qualitative impact of what they are talking about.

Indeed, this takes us back to the beginning of talk. The quantitative approach, which almost totally neglects the *essence* of things and knows nothing but units – whether people, or capital, or hectares – cannot help us to find solutions, because our problems have arisen precisely from this approach.

What is required is detailed, honest, painstaking work to create a technology with a human face.

Such work is already in train. It needs support (e.g. the Intermediate Technology Development Group in the U.K.). Such organizations do not demand sudden, total, violent changes. They demand that there should be a gradual change of emphasis.

Here lies the battle front of the future – between the people of the forward stampede – "a breakthrough a day keeps the crisis at bay" – and the homecomers who labour patiently to bring things back to the human scale.

Small is Beautiful.
Simple is Beautiful.
Non-Violent is Beautiful.

They labour to make a viable future already visible in the present. The churches, it seems to me, should be on the side of the homecomers.

IV

CARRYING CAPACITY OF THE GLOBAL ENVIRONMENT – BIOLOGICAL LIMITATIONS –[1]

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The carrying capacity of a farm is the number of animals that can be maintained indefinitely without the ultimate deterioration of the farm. Stocked beyond its carrying capacity a farm deteriorates and its carrying capacity falls. By analogy the world has a carrying capacity of people. The earth is finite in resources necessary to sustain the increasing numbers of people upon earth. If it is overstocked with people environment deteriorates and population must fall. Put that way the resolution of the problem should be quite simply framed. After all, a good farmer knows that it is to his advantage not to overstock and to work his farm at the carrying capacity or below. The motivation of nations and lesser groups of people is almost the reverse. So far as the stocking of the earth is concerned the motivation is to overstock and to keep on increasing, for that appears to be the way to reap the biggest advantages.

The Tragedy of the Commons

The reason for this difference is that the earth is more akin to a Commons than to a farm. The farmer who shares a commons asks – what is the advantage to me of adding one more animal to the herd? There is a positive component. It is the proceeds of the sale of this animal. It is nearly plus one. There is also a negative component which is a function of the additional overgrazing created by one additional animal. Since this is shared by all the herdsmen the negative component for me is only a fraction of minus one. So the only rational course for me is to add another animal and another and another. But this is the conclusion reached by each herdsman sharing the commons. It is what Garrett Hardin has called "The Tragedy of the Commons". It is the tragedy of the blue whale. It is the tragedy of the Sahara Desert. It is the tragedy of those fertile lands that form its southern boundary; there is not a single country who shares these lands which is not today increasing the southern movement of the Sahara Desert by about a mile a year. It was probably the tragedy of the once "Fertile Crescent", the great valley of the Tigris and Euphrates where agriculture began. It is the tragedy of the Western Division of New South Wales. It could be the tragedy of the world.

Behaviour which is rational over a short term may be quite irrational over a long term. The village idiot when offered a choice between sixpence and a shilling always chose the sixpence much to the villagers continued amusement. Finally one day a villager said "Look, I know that you are not that stupid, you know that a shilling is worth more than sixpence, so why do you always take the sixpence ? " "It's obvious" said the village idiot "if I took the shilling, they would stop making me the offer". If we take the shilling every time then one day there won't be any offer for us.

The world is a Commons. It is being mismanaged. In principle, the solution is simple. It needs a world Commons Control System. In practice there are enormous difficulties. Any major attempt to overcome these

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[1] Address to a Symposium on "The Consequences of World Population Growth", August 15, 1972, University of New South Wales.

difficulties would involve a revolution in individual ethics, social ethics and in economic and political systems. The difficulties can be seen easily enough in the use of those resources that are at present held in common such as oceanic fisheries. Such resources are almost never wisely managed by loosely organized groups because each group still seeks to maximise its own benefits. A strong central authority is needed. But we do not have it. Stockholm 1972 was one small step in that direction.

There are, of course, people who do not agree with this sort of analysis. They do not recognize the finiteness of the earth. They have the illusion that physics and biology have all the answers to problems of disappearing resources and increasing pollution. Nothing could be further from the truth. A great deal of our difficulty lies precisely in the backwardness of physics and biological sciences when it comes to the earth as a total system. But even allowing for this ignorance when we come up against finite limits, the laws of phsycis and chemistry are not going to be repealed by innovations in technology now or ever.

I. The Limit to Productivity of the Earth

There is one limiting factor to life on earth which can be calculated quite accurately. This is the planet's net bio-productivity. It is determined by the photosynthetic fixation of plants of 0.1 per cent of incoming solar energy. This is converted by plants into what can be only about 164 billion tons, dry weight, of organic matter. Two-thirds of this is produced on land and one-third in the oceans. The ultimate productivity of the land is, at the very most, about eight times the present level and from the sea, at best, about two times current production. This means that the total ultimate food production of the entire earth is no more than nine times the present level. But it is highly unlikely that the earth could ever support so much because plant production, which is what we are talking about, includes forests (and we presumably are not going to eat all these) and plankton in the sea (which we do not eat at all because it is unpleasant to eat and very difficult to catch). As I shall indicate in what follows, other considerations indicate that an optimally productive earth might at best support between one and five billion people in a comfortable existence, or roughly today's population (3.5 billion). And that too assumes that earth's productive capacity is not seriously eroded in the future but in fact improved over what it is now. If the productive capacity deteriorates (and there are signs of this which I refer to later) then we are already well beyond the carrying capacity of the earth and will have exceeded it very seriously by the turn of the century. The human population will then be in for a catastrophic crash in numbers. What is more likely to happen is that food shortage will not operate alone to reduce numbers but will be combined with the disappearance of some essential renewable resources, escalating pollution and the breakdown of a complex technological society. Only some form of world management is likely to be effective in avoiding this disaster, without that there is a high risk of the human race committing suicide.

The most obvious limitation to the amount of food the earth can produce is the amount of arable land. The supply of this is finite. It is completely inelastic. The absolute upper limit estimated by FAO is 3.2 billion hectares. Half of this is under cultivation today. The remaining half will require immense capital costs to settle, clear, irrigate and fertilize before it can produce food. The costs will be so great that FAO has decided that the expansion of food output must rely on more intensive use of currently cultivated land and not on new land development.

If we decide to incur the costs and cultivate all possible arable land, how many people could we expect to feed ? Assuming that the present average of 0.4 hectares per person is sufficient (the U.S.A. requires 0.9 hectares per person) then we can draw a curve for increasing world population and a curve of increasing land needs with time. Let us suppose that the population continues to grow at 2.1 per cent per year. Now we have to subtract a quantity each year because half a million acres disappear every day under concrete for roads and houses and factories. By the year 2000 all available land will have been used up. After that we face a desperate land shortage. Remember that we have made the most optimistic assumption that we can utilize all possible land. The human race has had an overwhelming excess of arable land for all of its history. And now within 30 years we will be faced with an absolute shortage on a global scale. The technological solution says the agriculturalist is to increase productivity. Double productivity and that gives a breathing space of just 30 years which is about one population doubling time. Double productivity again and you get another breathing space of a mere 30 years. The exact numerical assumptions we make about the limits of arable land are essentially unimportant in the face of exponentially growing populations !

The Green Revolution has been falsely hailed as the solution to the food needs of the world. Norman Borlag who invented it says that it cannot possibly cope with increasing population growth and at most will enable the world to buy two or possibly three decades within which to bring down birth rates. The fact is that world food production is only just keeping pace with population growth. That means that we are managing to sustain the existing level of misery for a large section of the world's population. Per capita food production remains what it was in the 1952 to 56 base period. The situation has, of course, improved in some developing countries. The Indian population grows at 2.6 per cent per annum and at present food growth is 2.9 per cent per annum. Continuance of the Green Revolution is absolutely dependent upon phosphatic fertilizers. On projected rates of use all known reserves of phosphate rocks will be exhausted within 65 years. Without phosphates Agriculture could not support a world population greater than 2 billion, that is to say two-thirds the present world population. But by 65 years' time the world population will be 11 billion.

When we read about great food surpluses in different parts of the world, even in some developing countries, these are economic not nutritional surpluses. The difference, at least for people, is vital. The ability to obtain food depends upon the ability to buy food and a lot of people in India and other places do not have that ability. Increased complexity of supplying larger populations is indicated by the fact that food industries in the world grow by 6 per cent per year. Global food production grows 3 per cent per year. Where does the other 3 per cent go ? It goes to offset the increasing complexity of getting produced food to the people. To provide twice the present amount of food we need 6.5 times as much fertilizer, six times as much pesticide and 2.8 times more power.

Guarded optimism amongst Agriculturalists is that we could feed the six to seven billion people who will be on earth at the turn of the century with very careful management. There is real doubt that we could sustain six billion over long periods. A biochemist, H.R. Hulett of Stanford University Medical Center, has estimated that at the U.S. average level of food consumption per capita, a billion people is the maximum that the world could feed for sustained periods. We could not feed the existing population of the world at U.S. standards by any form of known agriculture.

Food from the sea as a possible solution to the world's needs is, as Paul Ehrlich has said, a red herring. Some 90 per cent of the ocean is a biological desert. One per cent of the oceans produces 5 per cent of the food from the sea. The rest comes from coastal waters which are those most subject to deterioration from pollution. The present yield from the sea is 60 million metric tons.

Fisheries expert, J.H. Ryther of Woods Hole Oceanographic Institution, thinks it unlikely that it will even exceed 100 millions tons, though others think it could double. Two things stand between man and increased yield from the sea: over-exploitation and pollution. Since 1950 world fish yields increased each year, but this increase came to an abrupt halt in 1969; there was a decline of 2 per cent. Six major world fish stocks have declined markedly in the past 25 years and show no sign of recovery, they include the East Asian sardine, the Northwest Pacific salmon and the Atlanto-Scandinavian herring. In the early stages of fishing supply is virtually unlimited. Harvesting makes little or no dent in the supply. Soon techniques improve and they overtake replacement rates of the stocks. As stocks fall competition to get more is increased while the getting is good. The rate of fishing efficiency increases, until a point arises when improved fishing technology coincides with the near extinction of the species.

What about other sources of food ? British Petroleum has built a plant in France for culturing single celled organisms such as yeast on petroleum. The first year's production in 1971 was 1600 tons. These materials have been successfully used as stock feed which suggests that it might be wise not to burn all the remaining petroleum as fuel but to conserve it for growing food. However important this may be in the future it is not likely that petroleum grown food will help much in the next critical decade or two.

II. Limitations Inherent in Mono-Culture Agriculture

Limitations to crop production are imposed by problems inherent in monocultures, that is, vast expanses of single crops many of them of highly uniform genetical constitution. Agriculture tends to replace diverse communities of plants and animals with simple monoculture. Long ago Charles Elton, the distinguished English

ecologist, argued that the English should maintain their hedgerows between the fields because these were oases for many species in an agricultural sea of monocultures, fertilizers and pesticides. They provided a continual reservoir of insects and other predators that help to keep down pests. In California small patches of wild blackberries are planted in vineyards to prevent outbreaks of the grape leafhopper. The blackberries also have a leafhopper that feeds on them, parasites that build up on the blackberry leafhopper very effectively keep the grape leafhopper under control. Without the blackberries there are not enough parasites to keep the grape leafhopper controlled. So diversity helps.

In a part of Malaysia peasants used to have a big breakfast of kedgeree made of fish that swam about in the rice paddies. Along came the Green Revolution and a strain of rice that produces more crops a year. So the irrigation cycle was changed and the new one was not long enough for the reproductive cycle of the fish. So there were no more fish. The peasants had to have a breakfasr of plain rice and they fainted in the sun. Now there was in Malaysia a man who knew that this was going to happen with the new monocultures. He said 'you cannot introduce this rice until you have made arrangements to sell dried fish to the people to maintain the balance of their diet'. The only trouble was that they took no notice of him as they wanted higher yields quickly and so they had a small ecological disaster brought on by their monoculture. Monoculture, apart from getting rid of many favourable species that occur in a diversified community, are also much more subject to outbreaks of fungal and insect pests for reasons additional to the disappearance of predators that eat the pests. One reason is that the vast expanses of single crops provide an uninterrupted supply of food for pests. When the environment becomes favourable a population explosion of the pest can occur. This seems to occur with lower frequency in mixed communities, that is to say when the distribution of any one species is very patchy as opposed to being uniform. Unfortunately, our ignorance of all that is going on in monocultures as contrasted with mixed cultures is so great that it is difficult at this stage to formulate clear principles. One thing is clear and that is that only by much better management than we now exercise can the earth be turned over to monoculture agriculture without serious deterioration of its productivity. Most present efforts to expand food production entail some ecological cost. The classic modern example is the Aswan Dam with the loss of annual deposits of fertile alluvial silt in the lower Nile Valley. The same loss of nutrients has caused a precipitous decline in the fish catch in the Nile estuary.

Paul Ehrlich, in his 1972 revised edition of "Population, Resources and Environment", writes about Australia: "Unhappily, even though a larger population could well live there, the 'frontier philosophy' is even more rampant in Australia than in the United States in terms of environmental deterioration and agricultural over-exploitation." The evidence is in our semi-marginal agricultural areas, in the dry sheep belt, in the excessive use of pesticides in the cotton and tobacco growing areas and in the overstocking of cattle in the north.

III. The Pollution Absorptive Capacity of the Globe

Far from being a resource in unlimited supply, the pollution absorptive capacity of the globe is a limited resource which is extremely valuable. It is being destroyed as a result of some human activities. The official documents prepared by the United Nations for the Stockholm Conference stated: "The capacity of the natural environment to absorb and dissipate waste, without suffering intolerable damage, must now be regarded as an economic resource." The developing countries have most of this resource. The developed countries produce most of the pollution. So we need a world plan to use it aright.

Ecologists talk about self sustaining eco-systems. This bit of jargon means that in nature there exist communities of plants and animals that have persisted for aeons, that recycle most of their needs and that do not accumulate wastes. They are paragons of what many of us would like the human ecosystem to be like. Indeed the parallel to a possible future equilibrium society or stable society envisioned by some far-sighted ecologically minded economists is very close. One of the most wonderful examples of this stability is a tropical rain forest. The water that runs off the Amazon rain forest is as pure as distilled water. This is because the plants take up the nutrients from the soil so efficiently that none leaches away into the rivers which are called Black rivers like the Rio Negro. The system is virtually an enclosed or self-contained system, the only thing that comes in from the outside is virtually the energy of the sunlight. The underlying rocks are so far down that they do not replenish the supply of nutrients in the soil. The nutrient salts from the soil become plant tissue when combined with carbondioxide from the air (which came from plants and animals) with added energy of sunlight.

The leaves fall and plants and animals that feed on them die. In the soil they are quickly converted by bacteria to mineral salts that the plants take up again and so the cycle goes on and on as it has for aeons in the past. The system is a feed-back cycle in which every effect is also a cause. An animal's waste becomes food for bacteria and so on. Input equals output and output goes back into input. That is why Barry Commoner talks about these systems as circles. The title of his book is *The Closing Circle.* What man does to these systems is to convert them into a series of linear events. That happens when a rain forest is cut down and corn or potatoes are planted. These crops take up the nutrients in the soil. At most they produce two crops. The rain leaches out the remaining plant nutrients and unless fertilizers are added and other forms of management ensue the land erodes into the rivers. A closed circle has been converted into a linear sequence. There is little recycling in Agricultural systems. This is happening to the world's inland waters. Sewage and other organic wastes together with nitrates (from farms and motor car exhausts) and phosphates (from farms and detergents) flow into these waters. This results in a rapid bloom of algae. As the thickness of the algal layers increase, light for photosynthesis cannot reach the deeper waters and the algae die producing more organic matter which uses up oxygen in process of decomposition by bacteria. The river or lake becomes oxygenless and dies. Its purifying capacity is then largely gone. The cycle is broken and we get an accumulation of organic wastes left to the working of those bacteria that can decompose it without oxygen, but in the process produce foul smelling gases. It happened to the Thames. It is happening to the Parramatta River, which apparently needs an additional 50 tons of oxygen a day to recover. Our waste systems do not take into account the circularity of the ecological systems into which they intrude. By 1980 the oxygen demand due to municipal wastes in the U.S.A. will equal the oxygen content of all the river systems in that country in the summer months.

A second impact of pollution is that somes pollutants are acute or chronic poisons. The solution to pollution was thought to be dilution. We found to our cost that it is not. The persistent insecticides such as DDT and Dieldrin, the radioactive fall-out substances such as Strontium 90 and the plasticisers polychlorinated biphenyls or PCB's, never occurred on the face of the earth until man made them in recent years. They all present the same problem and for three reasons; they are relatively long lived, they disperse far from the places where they originate and thirdly they become amplified in concentration in biological food chains. As a result of this predatory birds are dying around the world because they are at the top of food chains which accumulate both pesticides and PCB's. The birds are biological indicators of something that is happening to our environment. In so far as these substances accumulate in food chains they also get into our food and are a hazard to man. Similarly, Strontium 90 gets into food chains and because it is a bone seeker, it gets concentrated in bones where it does its damage if the concentration is high.

Because of these facts we should not be impressed when we are told of the low concentrations of these substances in the soil and waters of the earth. It is not the average concentration that matters. Remember the statistician who drowned in a lake of average depth of two feet ! I do not therefore regard DDT and Dieldrin and Strontium 90 as just another lot of pollutants. They are the ultimate pollutants about whose long term effects we know very little. What we do know is that virtually no living organism on earth is free from them. It is just lucky for the human race that DDT was not more toxic than it is to non-target organisms. Otherwise we could have had it.

The case of mercury is rather different. Fish in the sea have apparently from ancient times accumulated mercury from very low concentrations in sea water. Fossil fish show this to be the case, Whether it hurts the fish or not we do not know. Their tendency to do this however is hazardous for man when he increases the quantity of mercury in the water from factory effluents and then eats the fish. Man in this case is aggravating an effect which has been going on without his intervention.

Another class of polluants are gases liberated into the air we and other organisms breathe. Some are toxic. Pine forests on the San Bernardino Mountains near Los Angeles have died from smog. The death rate from emphysema in New York rose by 500 per cent in the nineteen sixites. This increase was almost certainly due to constituents of smog. The biological problem here is twofold. Toxic gases accumulate to levels that cause disease and death. Further, large amounts of these gases enter the troposphere (zone up to 40,000 feet) and there they could alter the heat balance of the earth in ways not yet understood. The only solution is not to produce them. One of the major offenders is the automotive industry which is very reluctant to cut down these effluents for no others reason than increased costs that would mean for their motor cars. Since automobile industries employ people and add to the GNP, governments are reluctant to put pressure on them. But why should they determine

the quality of the air we breathe ? Despite figures on air pollution in Australian cities that put us in world class, the automobile industries in Australia as recently as half a year ago said that air pollution was not bad in Australian cities and did not justify expending fifty dollars per vehicle. It will probably be a case of staggering from calamity to calamity. On a global scale the threat at present to the pollution absorption capacity of the earth seems greatest in estuartes and coastal waters (where most fish are produced), in inland lakes and rivers and in global atmospheric pollution by both large and small particles.

CONCLUSION

The world of the future will have to be managed as a gigantic commons. At present about eleven per cent of the land surface is intensively managed, thirty per cent is moderately managed and fifty nine per cent is not managed at all; and of the latter about half is currently not usable by man. Most of the marine and fresh waters of the planet are not intensively managed. We now know that management is necessary as soon as man intrudes on self-sustaining biological systems. If we are to preserve the integrity of the life support systems of the earth our management will have to be moulded much more than it is now on self-sustaining ecological systems of which the rain forest is a prime example. As far as possible outputs (consumer goods and wastes) will become inputs (production). The rate of input and the rate of output should be as low as possible for stability of the system; too rapid inputs reduce resources and pollutants block overtaxed recylcing systems. We would aim to make the parallel with nature as complete as possible with the sole source of energy being provided by the sun. Instead of spending untold billions on making bigger and better atomic power plants (with their quite unresolved problems of waste disposal) we should seek to harness the one and only non-polluting source of energy, the sun, just as the plants do. The environment is not simply a stage on which the drama of life is performed. It is itself part of the drama. Stage scenery and actors are all made of the same stuff. Our entrance is a transformation of the stage. Our exit is a return to the substances of the stage. The oxygen in the atmosphere comes entirely from plants. It is entirely renewed by living organisms every 2000 years. Every molecule of carbondioxide in the air, water and soil goes in and out of living organisms. It is entirely renewed every 300 years. The only reason we have a lot of nitrogen in the atmosphere is that certain bacteria put it there. Even every molecule of water on the earth goes in and out of living organisms and is completely renewed every 22 million years. Keep the earth this way. Keep the molecules moving !

V

THE SEARCH FOR A BREAKTHROUGH IN THE FACE OF FINITE RESOURCES : SOME DILEMMAS FOR SCIENCE AND SOCIETY

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1. Optimism and Pessimism in the Discussion of Finite Resources

Recently we have heard much discussion about the limitation of resources on the earth. Some are optimistic and the others are pessimistic. I am rather pessimistic about this problem, but, explaining my point of view, I would like to set forth a thermodynamic perspective on resources.

Roughly speaking resources may be classified into two categories – material resources and energy resources. However, the border line between the two categories is quite opaque; coal can be looked upon as an energy resource and also as a material resource, since many kinds of chemicals and drugs can be obtained from it. Moreover, it is not certain whether our foods are material or energy resources since we obtain both our life energy and the building components of our body from foods. I will therefore give up the delineation of two categories and discuss resources only from the energy point of view.

Thermodynamics teaches us that there are two kinds of energy – free energy and bound energy. Free energy can be used for any form of work including mechanical, chemical, and electrical work; but bound energy cannot be utilized in work unless some special condition is fulfilled. Under the condition of constant temperature, such as in our body, bound energy cannot be used for work at all. Thus it should be clear that our lives are sustained by free energy rather than bound energy.

Another important principle of thermodynamics is that whenever some changes, including chemical reactions, take place free energy is converted into bound energy. Conversely, any change taking place decreases free energy. To carry out our daily life an enormous number of reactions need to proceed, both inside and outside of our body. Thus we are dissipating a large amount of free energy to sustain our life, and without the supply of free energy we cannot maintain life.

The source of free energy supply can be called natural resources. We have many kinds of resources, but they can be classified into two categories: outside-earth resources and earth resources. An example of the former is sunlight. Examples of the latter are coal, petroleum, foods, wood and atomic energy. However, coal and petroleum can be looked upon as materials where free energy of ancient sunlight has been trapped.

Clearly there are definite limits to the amounts of coal, petroleum and atomic energy. The only resource, for which there is no limit is sunlight. Green plants are synthesized by utilizing the free energy of the sun and animal resources are cultivated by utilizing the free energy kept in the plants.

Although there is a limit to the amount of free energy of the sun we do not think that it will be totally consumed in hundreds, thousands or millions of years. Can we then affirm optimistically that our natural resources are secure ? Here is the problem. In utilizing sunlight, the important thing is not the total amount of free energy of the sun but the rate of its availability. Thus, if the rate of consumption of free energy exceeds the rate of its supply from the sun we will definitely face a catastrophe where we are desperately deficient of free energy.

It is clear that the wager for optimism or pessimism will be completely determined by whether we can decrease the rate of consumption of free energy or not. I emphasize again that without the conversion of free energy into bound energy we cannot support life; because the consumption of free energy is unavoidable for life. However, we can discard bound energy into space. The important thing is whether we can maintain a dynamic equilibrium between the supply of free energy by the sun, and the discard of bound energy into space. If we cannot keep this equilibrium, due to the overproduction of bound energy, our situation is definitely serious.

What factors will result in the consumption of free energy leading to the overproduction of bound energy ? We can enumerate many, and I note here only a few examples. One is the explosive increase in population. Another is the rapid progress of engineering or industrial processes. Both consume free energy, since without this consumption both life and industrial processes cannot be realized.

Another important factor, which is now the focus of our attention, is pollution. Pollution has of course something to do with the dissipation of free energy since most of the pollution substances are full of bound energy rather than free energy. However, my opinion, the main role of a polluting substance is to inhibit or at least decrease our usage of free energy.

I have thus mentioned three factors, which will consume free energy in large amounts. Can we stop them ? I am rather pessimistic about this, because these factors are closely connected with our apparently productive and happy life. Will people agree to be robbed of their leisure, of their right of parenthood ? Here is the first dilemma.

2. Difficulties in the Practical Application of the Principle

From what I have said above we can understand the principle for the utilization of finite resources. Instead of exhausting natural resources we have to bring them in a steady state. Steady state means that the supply of free energy from the sun balances the dissipation of free energy.

However, problems arise in the application of this principle. I may refer to two points. The first concerns social, economical, political, ethical and religious problems. Can we stop or minimize the industrial process ? The developing countries would oppose this proposal because they are just starting the processes leading to happy and productive lives. Even Japan, which is poor in natural resources, poor in field areas and forced to depend on industry may oppose it; and I am seriously afraid that some countries like Japan might go to war to protect the apparently happy life of the nation. I should confess that the last world war was due to the sin of our nation; yet another war can take place so long as people persuade themselves of the need to fight for their material welfare and happiness.

Can we stop the increase of population ? Aside from the religious point of view, the minority would oppose this proposal because they think they will be happy only when they have come into balance with the majority through population increase. Here is another source of conflict.

Can we decrease pollution ? We have to realize that a larger amount of pollution is due to agricultural chemicals, and the decrease of such chemicals would result in serious decrease of agricultural product. This will become a serious problem, if we consider the estimated increase of population in the near future. It would result in poverty, starvation, war and is completely against the demand for happy and productive life.

Thus it is clear that any endeavour to decrease the dissipation of free energy will be opposed because it is against our idea of happy and productive living. Since these problems are related to political, economical, sociological and scientific concerns we need interdisciplinary discussion involving all these fields. However, I would like to emphasize the ethical and religious point of view. Our apparently happy and productive life, which I have mentioned repeatedly is almost altogether concerned with material welfare. We have to find and establish the basis of a truly happy and productive life. We need more and more to discover the spiritual meaning of happiness. It is the task of the W.C.C. to establish and propagate such new understanding.

The second point is more from a scientific point of view. We know the problems of pollution, the limit of natural resources and overpopulation. These are connected with environment. In my opinion, environment involves two fields, at least – natural environment and cultural environment. The problem seems to be how to bring the optimal natural environment. Since cultural environment is deeply and complexly implicated in the maintenance of the natural environment it provokes interdisciplinary discussion of ethical and religious importance.

With regard to the natural environment, it is quite difficult to define the optimal situation. You may immediately think of Utopia when you hear about optimal environment. Can it be true ? If Utopia means life which can be spent working, exercising, or eating as we choose, or life in an environment which affords us every necessity without compensation, it cannot be optimal. An optimal environment is one which gives us the optimal stresses in an appropriate time. Even some of the toxic hazards or polluting substances may play the role of stress agent for us. We do have a hereditary wisdom called adaptation and the stresses, if under a certain level, provide us with the capacity to face a difficult situation through adaptation. Without adaptation our survival would be hopeless. However, if the stresses are above certain levels we cannot survive at all.

The problem has now become what is the stress and how we can determine the optimal stress level. These belong to the ecological field but unfortunately we are not in position to give a definite answer. Such problems, including pollution, cannot be left in hands of so-called ecologists only. Ecology needs several generations to assay human adaptability, but this would be too late. It is quite urgent to establish interdisciplinary or multidisciplinary projects to solve these problems.

3. What is the Role of Biological Sciences ?

One way by which to find a breakthrough in this difficulty might be the utilization of the biological sciences. On one hand, by combining several fields of biological sciences we may be able to discover the nature and level of optimal stress in our environment. On the other hand, if for example, you compare the amount of free energy consumption for producing the same quantity of natural and synthetic fibres you will realize that the former needs far less energy consumption than the latter. This means that biosynthetic process is much higher in efficiency than the artificial synthetic process. Nevertheless to meet the needs of explosive population increase we may need more biological science.

The old testament said "a bad tree cannot bring forth good fruit". In order to increase biosynthetic output we might need to cultivate good trees. This has something to do with eugenics and for such purpose we need biological science. We should be aware however that we have not learned what kind of backlash may come from the natural environment should such projects proceed. Here is another dilemma. A similar point arises in the medical sciences.

In the field of molecular biology, we have made remarkable progress recently. You may grasp the extent of the progress from the fact that more than twenty Nobel Prizes in the last fifteen years have been awarded to molecular biologists. Among the large number of achievements of molecular biology, I mention today only genetics. Recent progress of molecular genetics has clarified the nature of heredity. Now, we know what composes the genetic material which is called gene. It means that we can change the genetic information at our will and also that we will be able to synthesize any form of genes in the near future.

Is this progress for human welfare ? The benefits could be great. We know many troubles which are associated with heredity. The progress of the molecular genetics suggests the possibility of overcoming such troubles. This might be achieved by gene transplantation. If the gene of a clever man is transplanted to a fool, the latter will be clever. If the gene of a normal one is transplanted to one who is colour blind he need no more worry about his trouble.

Gene transplantation may be called artificial evolution, since natural evolution is also a result of a change in genetic information. However you may feel some uneasiness in hearing about all this. We are creatures and natural evolution may be seen as a product of Nature. Artifical evolution is the product of human beings Can this be allowed from the theological point of view ?

However aside from the religious problem, as a humanist I feel the knowledge of gene transplanting is dangerous. The possibility of curing the foolish suggests also that you can make anyone foolish quite easily. If you can cure the disease by gene transplantation you can also make healthy people suffer from a serious disease.

Recently we have seen a flurry of organ transplants which have posed similar ethical and religious problems. However, organ transplant requires human donors, is very expensive and is not applicable on a wide scale. But gene transplanting can be easily achieved by using the gene of one cell of your skin; it is not expensive and is easily applied on a large scale. This means that gene transplantation has a great possibility of being used as a biological weapon. Once used as a weapon the result will be a disaster. I should add that preliminary experiments with gene transplantation have succeeded.

We have come therefore to a great dilemma. Should we stimulate or stop the progress of molecular biology ? Furthermore, have we any serious evidence in history that any kind of stress has succeeded in stopping a science ? What should we do then ?

4. Conclusion

These developments prove that the exploitation of the future cannot be left in the hands of natural scientists. Natural science is superior to any other science in explaining the natural phenomena. Starting from observation it abstracts a rule as a hypothesis, which is tested by experiment and leads to a theory. However, natural science cannot evaluate its own real value for human beings. Natural science has no capability of judging whether its results will be applied for a good or bad purpose. If you order us to, we natural scientists can synthesize antifertility chemicals, which can be widely applied, for example by adding them to foods or to city water, just as vitamins are now used to fortify various foods.

However, we cannot judge for society if this is good or bad. Birth control programmes might be accused of reflecting the egoism of existing people, and neglecting those who are coming. This is an ethical or theological problem. One group of people will object to birth control imposed by another group unless individual are treated fairly regardless of their race or religion. Many problems of social science, of social justice, humanity and religion need to be solved before we, natural scientists, can establish valid projects leading to the right use of finite resources. Above all, we have to change the existing conception of human happiness. This is a large demand but also an important responsibility of a body like the World Council of Churches.

For the future we need intense discussions at the interdisciplinary level. However, it seems difficult to obtain fruitful interdisciplinary discussions unless various disciplines are represented by people who have mastered their discipline and who can develop humility to realize that when we deal with ideas of other people we must be able to listen as well as to advocate.

It cannot say that we will surely find a breakthrough. Our sin might be too large and keep us from achieving this. Ultimately only God can guide us through these dilemmas. But, this does not mean we can avoid our responsibility to act. The Lord would say "You wicked lazy servants, you knew that I reap where I do not sow, and gather where I scattered no seed ? " We must do what we can.

VI

THE WORLD POPULATION SITUATION

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Even in the second half of the twentieth century, there still exist a number of countries whose population is not accurately known. Amongst these, the most inportant is China, for which the United Nations Population Division gives a range of between 732 and 828 millions. But, in spite of defective data for individual countries, less uncertainty attaches to the population of the world as a whole, as it is unlikely that all individual errors will be in the same direction. The United Nations estimate that the world's population in 1970 was somewhere between 3,545 and 3,648 million people, and is therefore known within an accuracy of 3 %. We shall not go far wrong, if we accept a figure of 3,600 million for 1970.

At the beginning of this century the world's population was estimated as 1,646 millions, so that numbers of mankind have more than doubled within the lifetime of some of our older contemporaties. For every 100 persons alive in 1900, there were about 220 in 1972. Moreover, the rate of increase has been accelerating, the United Nations estimate that during the period 1960 to 1970 world population grew at the rate of 2 % per year. As population increases in accordance with the law of compound interest, this implies a doubling of human numbers about every 35 years. In all probability this is a faster rate of growth than human populations have ever experienced before. It is concern with this very fast rate of growth that has led to the recent upsurge of interest in population matters.

So far figures have been given for the world as a whole. But in this particular area. it is important that the world is divided into a number of different sectors with very different demographic characteristics. A recent UN publication considers the demographic situation of the more developed and the less developed countries of the world separately. Their rates of growth are very different. In the decade 1960-1970 the population of the more developed areas increased at the rate of 1.1 % per annum, that of the less developed countries by 2.4 %. Latin America, the fastest growing continent grew at the rate of 2.8 % per year, as did the population of Southern Asia. The African rate of growth is 2.6 % per year and that of East Asia 1.8 %. At the other end of the scale, Europe's annual rate of growth was 0.8 %, that of the Soviet Union 1 % and of North America 1.2 %. Clearly, the distinction between the more and the less developed areas is crucial, the former doubling in numbers every 29 years, the latter only every 63 years at present rates.

Obviously, rates of increase of this magnitude cannot continue indefinitely, for the area available for the settlement of mankind is only finite. Even developed countries which are growing slowly at present, are increasing at a rate which implies a doubling in numbers every 63 years, and a country with a very low rate of growth such as the United Kingdom would still double in less than 200 years. In the very long run, no rate of growth different from zero can be maintained. This does not mean that births and deaths must be exactly equal each year, there will undoubtedly be oscillations about a zero value. It does mean, however, that population increase in any one year must be balanced by decreases in others, and that we shall have to get used to the idea that deaths in particular years will exceed births.

The "population problem" at the present time is that of reducing the rate of growth. It may be possible to achieve this through deliberate social action, though this is by no means certain. Unless this proves possible, however, birth and death rates will have to be brought into equilibrium or near equilibrium through other and more unpleasant means. We must therefore proceed on the assumption that men will be able to adapt themselves to this new situation as they have adapted to other new situations. To assess the likely success of action will make it necessary to investigate how the very large present rate of growth has come about, so that we shall be able to see where it can best be attacked.

On a global scale population increases by an excess of births over deaths. A high rate of population growth can therefore be caused by a fall in mortality or by a rise in fertility. The escalation in growth rates appears to have been triggered off by a fall in the death rate. It is not always realized how very large that fall has been in relatively recent times. To take the United Kingdom as an example, some 125 years ago one-quarter of all the male babies born in this country had died within 2 1/2 years of birth, the corresponding age for female babies being slightly higher. In 1961, on the other hand, three-quarters of male babies born survived to 62 years of age, and three-quarters of female babies to the age of 69. In the developed countries this revolutionary change in mortality was brought about by a number of factors: increase in the standard of living, improved techniques of food production, a better knowledge of personal hygiene and public sanitation and, latterly, improvements in medical and therapeutic techniques. This improvement in mortality tended to be confined to the more developed countries of the world until about 1940. In the less developed areas mortality remained high and life was short. However, the second world war brought about advances in the treatment of disease, both by community measures such as mosquito control against malaria, and in individual therapy through new drugs and antibiotics, so that mortality began to fall in the less developed countries too. Sometimes the fall was exceedingly rapid, the case of Ceylon is often quoted, where the death rate fell by one-third within one year of an insect control programme in the late nineteen forties. The expectation of life at birth is still relatively low in Africa (about 40 years), but in has risen considerably in South Asia (to 50 years) and in Latin America (to 60 years). In the more developed areas of the world, the expectation of life at birth now generally equals or exceeds the psalmist's life span of three score years and ten. Even areas in which the expectation of life is still low have shown considerable improvements in the immediate past. Differences in mortality are therefore narrowing, though people in the more developed countries still show an advantage as compared with those living in the less developed areas.

In Europe and America the reduction in mortality rates began in the nineteenth century and this led to a spurt of population growth then, though even the fastest rate of natural increase in the West in the nineteenth century was considerably lower than the 2 % at which the less developed areas are increasing today. Their spurt, in the twentieth century, has also been caused by a fall in death rates. There are several reasons for this. In the first place, a fall in mortality means that more people survive to become adults and to reproduce and have children in their turn. Secondly, where mortality is high, restraints on fertility are reduced: parents who wish for surviving children will know by experience that they risk losing some in infancy and childhood and will therefore attempt to ensure the survival of some progeny by having large families. These high-fertility norms persist for some time after mortality has begun to fall, so that the gap between births and deaths widens and the rate of growth accelerates. Thirdly, a decline in mortality is often associated with an improvement in health and vigour of the population and may lead to an increased capacity for reproduction. There can be little doubt that the recent quickening of the rate of world population growth is due to a fall in mortality, coupled with persistent high birth rates. The UN figures tell their own story: in 1965-70 birth rates (admittedly not an altogether satisfactory index of fertility) were 18.6 per thousand in the more developed and 40.6 per thousand in the less developed countries. A slightly better measure of fertility, the gross reproduction rate, which measures the number of daughters a woman would have at the age of 50 in the complete absence of mortality before that age and if current fertility rates persisted was 1.3 in more developed and 2.7 in less developed countries. Fertility rates are particularly high in Africa and South Asia, where the gross reproduction rate exceeds 3. In terms of total family size this probably means an average family of more than four children per married couple.

In the Western world the reaction to the fall in the death rate in the nineteenth century was the almost universal acceptance of voluntary family limitation. In almost all countries births of higher orders declined, and the average size of completed families fell to a figure of 2.2 to 2.3, from a figure which was probably about 6 children per family in the early nineteenth century. (In some countries the average figure was even higher, for instance, in Ireland women living in rural areas and married for some 25 years in 1911 were returned as having an average of nearly 8 children per family). The fall in fertility was faster in those countries where it started late, than in areas such as the United Kingdom and France, where it began relatively early. There are some writers who take the view that the fall in death rates in the less developed countries in this century will, as was the case in the West, be followed by a decline in birth rates. It must be emphasized that even if this prognosis proves correct, the population would continue to grow for some considerable time to come. For instance, it has been calculated that if married couples in the United States suddenly reduced the sizes of their families to a level which would just be adequate for replacement, the population of that country would continue to grow for another 60 years, before stabilizing at a figure some 38 per cent higher than at present. In less developed countries where there is a

younger age distribution stabilization would result in a larger figure. Remember also, that nowhere in the world has any country, as yet, reached a stage in which population is only just replacing itself.

To forecast population growth is a hazardous undertaking, and most past forecasts have been overtaken and falsified by events. The most recent medium variant projection by the United Nations, assumes that world population will continue to grow at the rate of 2 per cent per year, until 1985, when the increase will gradually begin to slow down. Many would regard this as an optimistic assumption. But it would involve a growth in the world's population from 3,632 million at present to 6,949 million by the end of the century. The less developed countries which contained 2,542 millions in 1970 would grow to 5,040 million by the year 2000. To give an example of what this means in educational and social terms, it has been stated that in Latin America, an area in which there is heavy unemployment and underemployment, 84 million people will be added to the labour force within the next 15 years and there will be an increase of 38 million in the population of school age.

There will thus be two major problems in the demographic field facing the world during the remainder of this century. There is the virtual certainty that numbers are likely nearly to double during the next 30 years. At the same time steps will have to be taken to try and reduce the rate of growth from its present excessive level to a much lower figure, and ultimately to one which is not significantly different from zero. A reduction is most urgent in the less developed areas of the world, but the more developed areas, too, cannot continue to increase, even at the lower rates compared with developing countries, indefinitely.

Obviously, no one would wish to reduce the rate of growth by increasing mortality. Any deliberate policy designed to cut off areas of high fertility from access to the means for the further reduction of their death rates would be unthinkable. Therefore, any attempt to reduce population growth will have to proceed through an attempt to influence birth rates and fertility rates. The fall in these rates which has been a feature of the demographic history of the more developed countries has been brought about by the widespread adoption of deliberate means of family limitation or birth control. Technically, the limitation of families has become easier and more efficient with the development and improvement of techniques of contraception. These have developed from methods which were coitus-associated, such as the condom, the diaphragm and chemical spermicides, to methods not associated with coitus such as the steroid pill and the intra-uterine contraceptive device or IUCD. But, although modern methods have been more efficient in preventing contraception, when properly used there is still room for improvements in contraceptive techniques through the elimination of unwelcome side effects and increased acceptability. The major problem, however, is not one of devising a more efficient or acceptable contraceptive method; it is rather that of making men and women aware of the availability of contraceptive methods making these methods available to those who are in need of them, and persuading the population to use them.

Attitudes towards contraception have changed very considerably within the lifetime of most of us. Not least important amongst these changes has been the development of Christian thought on the permissibility of birth control. In the nineteenth century birth control was a subject which was *inter Christianos non nominandum.* As I understand the situation today, there is now no sizeable body of opinion within the Christian Churches, which would deny that it is the moral responsibility of married couples not to have more children than they can reasonably support. And outside the Roman Catholic and the Mormon Churches it is now generally agreed that appliance methods, chemical, biochemical and mechanical methods of contraception and *coitus interruptus* are permissible, provided they are accepted by both spouses. Roman Catholics, however, are still forbidden by the official teaching of their Church to use any method of family limitation, other than abstinence of the "rhythm" or "safe period" method, a method which is less efficient in preventing contraception than the others. It is, however, difficult to avoid the impression that many Roman Catholic couples, particularly in Western countries, do not follow their Church's teaching in this matter. Indeed, considerable discussion is still taking place within the Roman Catholic Church about the question of the moral justifiability of so-called "artificial" methods of birth control. However, the official attitude of the Church has on occasions made it more difficult to provide population control programmes through contraception in some countries.

It will also be necessary to examine the attitude towards abortion. In the absence of contraceptive services, abortion is still a very widely used method of population control, even though it would probably not be the first choice method of many people. Nor is the distinction between contraception and abortion always clear cut. If new contraceptive methods were developed which would prevent the implantation of the fertilized ovum, and there is discussion of such methods, would this be contraception or abortion ?

It would be wrong, however, to regard the attitude of the Churches as being a very important obstacle to the more widespread adoption of fertility control in less developed countries. There are other and more important factors: poverty, ignorance and lack of organizational facilities. These latter apply particularly among scattered rural populations, where the problems of organising an efficient distribution service for contraceptives are considerable, and where medical facilities for, say, the insertion of IUCDs or the supervision of women who take the steroid pill are limited. Ignorance about their own reproductive physiology among women, and fears about possible ill effects associated with the use of contraceptives may also be important factors. There are also objections on the part of men, who fear that if women were able to avoid pregnancy after intercourse, they might be unfaithful to their husbands. But more important than any of these factors, perhaps, is the fact that in many less developed societies women gain social status and esteem through motherhood, and particularly in becoming the mothers of sons, and that for some of them there is no alternative way of getting such esteem. The production of large families may be perceived as benefitting the individual family, and the association between high fertility and lack of development may not be at all obvious.

It is not, therefore, sufficient for a reduction in the growth rate, to provide contraceptive advice or contraceptive devices. These must be accompanied by an educational programme designed to encourage people to have fewer children, to show them that this is to their own long-term benefit and to bring about a situation in which there will be an incentive for people to limit their families. This will imply, particularly, the provision af alternative opportunities for self-realization among women, and to enable them to achieve status through means other than procreation. It will also mean raising the standard of living and the aspirations of the populations of the less developed countries. Birth control by itself is not enough; it is unlikely that population control programmes can succeed, unless they are accompanied by economic and social development.

However, it is necessary always to remember that population increase is not merely a problem of the less developed and poorer countries. Even in more developed areas population continues to increase (and, incidentally, given the disparities in standards of living, their relatively low rate of increase may make disproportionate demands upon resources, compared with the larger relative increase of the developing areas). And if people in the richer and more developed areas of the world merely preach the gospel of population limitation to their poorer and less developed neighbours, without taking steps to limit their own growth rates, they will risk a reaction from the less developed parts of the world, which will regard population limitation as a device invented by the rich for the maintenance of existing social and economic inequalities.

But a reduction in the growth rates of developed countries may well prove more difficult to achieve than in the developing world. There are clear benefits to be gained for the individual woman by changing a situation in which she effectively spends most of her reproductive life in a continous state of pregnancy or lactation. Provided that the organizational and psychological difficulties which have been pointed out in previous paragraphs can be overcome – and the magnitude of this task should not be underestimated – there would seem to be some chance of success of reducing excessive growth rates, though nowhere in the world has a near zero rate of growth yet been achieved. Some success is already visible in certain regions of South and East Asia, mainly in the city states of Hong Kong, Singapore and in parts of Taiwan, though pessimists could point out other parts of Asia and other regions of the world in which the impact of control programmes has not been apparent. Nor is it clear that progress is proceeding sufficiently quickly. In the developed areas, however, where family size is already low and standards of living high, the benefit to individual families of reducing their fertility still further is by no means obvious. Moreover, political, economic and fiscal programmes, designed to slow down population growth, which might discriminate against large families are unlikely to be popular politically, or consistent with the ethos of a democratic social policy.

The problem faced by people of all nations is one of considerable psychological readjustment. The injunction to "be fruitful and multiply" was necessary for the survival of the human species, in an era when mortality was high and the hazards of life great. We have now reached a position, where the danger to organized human survival appears to come from an excessive, rather than a deficient fertility. Adaptation to this new situation calls for a complete restructuring of attitudes and for a reversal of long-held values. The speed of social change and the rate of growth have both increased so greatly in recent years that the time available to achieve these attitudinal changes has become frighteningly short. This is the central nature of the population problem of today.

VII

ECOLOGY AND ECUMENISM

Maurice F. Strong,

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(Excerpts from an Address on "The Relevance of the Stockholm World Environment Conference to the Church" to the Central Committee of the World Council of Churches, Utrecht, Netherlands, August 18, 1972)

The decision to hold the first world conference on the Human Environment was made by the General Assembly of the United Nations in 1968. At that time, while the environment was rapidly emerging as a public issue in the more industrialized countries, it was still being viewed in most developing countries with a combination of apathy and suspicion. And in retrospect, it is not difficult to see why. For even in the industrialized countries the issue was seen in relatively narrow terms – primarily as a problem of pollution and other evidences of environmental deterioration, ills stemming from the same processes of industrialization and urbanization to which they owed their affluence.

In this sense, then, the environmental problem was seen largely as a disease of the rich – a condition not to be feared and perhaps even to be envied by the poor. Indeed, the doubts of the poor arose from their concern that preoccupation by the rich with the environmental "fad" would divert attention and resources from their own basic and compelling problems – problems arising mainly out of their poverty and under-development. For a man who may be faced with starvation or disease today, the risks from contamination of the seas or of the atmosphere seem so remote as to be irrelevant.

Thus, they wanted the Conference to direct its attention to the special environmental problems which they were experiencing as a result of their very poverty and lack of development – to the priority requirements of their people for the elementary ingredients of a better life – food, health care, housing, education and jobs – to the urgent demands of urban populations growing at rates without precedent in human experience – to the massive problems of soil contamination and erosion which rob them of much of their "natural capital" – and, perhaps above all, to the critical need of supplying life-giving water in both rural and urban areas. And they wanted to know how the growing environmental concern of the more industrialized countries would affect the flow of finances for their development, the cost of the capital equipment they buy from us, their access to our markets for products that may be subject to new environmental-based restrictions, and their ability to attract new industry to their countries...

All of these issues have a deep and compelling relevance to man's relationship with his natural environment. But to deal with them required a broadening of the entire concept of the environmental challenge far beyond the early perceptions of it as seen from the industrialised world. Indeed, it was somewhat of a paradox that developing countries appreciated more than many in the industrialized countries the need to set the problem of pollution in the perspective of a much deeper and more pervasive malaise threatening the entire body of mankind and inextricably bound up with a whole series of other threatening imbalances in which the fate of rich and poor alike was joined. Inevitably, the more one looked into the environmental issue, the more it became apparent that it required a new view, not only of man's relationship with the natural world, but with his fellowmen.

For the problems of the poor cannot be seen in isolation from those of the rich, and any attempt to do so would be self-defeating. We are not faced with many separate problems, but with different aspects of a single

over-riding problem – the survival and well-being of *all* men and their development, material as well as spiritual, in harmony with each other and with nature, in face of the awesome power which science and technology have placed in the hands of this generation.

The rapid growth of human population and the intensification of man's activities are placing growing demands on the basic resources of water, soil, energy, minerals, plant and animal life, and pouring into the atmosphere and oceans of the world mounting tides of chemical and other pollutants which threaten the very life-systems on which man's survival depends. We don't know where the critical thresholds of irreversible danger lie, but we do know that the whole human family is confronted with risks that could be decisive for the continuation of life – or at least human life – on this planet.

Conceived in its broadest terms then, the environmental issue poses the question of how man is to manage the world's first technological civilization. And the principal characteristics of this civilization are the scale and complexity of the interdependencies it creates – the interdependence of man and nature and the interdependence of man with man.

If we can succeed in harnessing this emerging awareness of our interdependence and in channelling it into a common effort to build a new global society for man – then surely the environment can act as a powerful impetus to human development...

The Declaration agreed upon at Stockholm represents a major step forward as the first acknowledgement by the community of nations of the new principles of behaviour and responsibility which must govern their relationships in the environmental era. And it provides an important – and indispensable – basis for the establishment and elaboration of the new codes of international law and conduct which will be required to give effect to these principles.

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An *Action Plan for the Human Environment* was also adopted at Stockholm, consisting of 109 recommendations for specific kinds of actions to be taken principally by governments and international organizations, many of them requiring extensive participation and complementary supporting action from non-governmental organizations and citizen's groups. They help provide the knowledge required to enable societies to evaluate the real consequences of the decisions by which they are shaping their own future...

The *Environmental Management Activities* and various *Supporting Measures* in the fields of public education, technical and financial assistance decided upon at Stockholm are designed to assist implementing these decisions. Together, these constitute a turning point in man's endeavours to preserve and protect his planetary heritage... The Conference also agreed to recommend to the United Nations' General Assembly the establishment of a new mechanism within the framework of the United Nations to enable the Action Plan to be carried out and to provide a permanent means through which governments can continue the process begun at Stockholm of identifying the needs for common international action, deciding on priorities, and agreeing on the allocation of responsibility and of resources to carry out agreed measures. The organization recommended would consist of a 54 member governing council, a secretariat and a world environment fund. If the General Assembly approves the recommendations at its forthcoming session in September, the new organization could be established early in 1973.

The success of Stockholm will now depend on the extent to which governments both nationally and through the international community, carry out the recommendations of the Conference and commit themselves to a continuation and acceleration of the processes which the Conference began. And this, is turn, will depend very largely on the extent to which private citizens and the non-governmental groups and organizations through which they operate, maintain and deepen their own commitment and their own participation in the programmes of public education and citizens' action on which any large-scale and sustained progress towards environmental sanity must be based.

Stockholm was perhaps most important for the demonstration it provides that unity of purpose to advance the larger concerns and interests which override the narrow barriers that divide men can indeed be a powerfully

creative and effective force in the affairs of nations... The environmental challenge creates a new and complex system of interdependencies which call for new dimensions of collective action... The word we use to describe these interdependencies in the physical world is "ecology". It is the equivalent of "ecumenism" in the moral and spiritual world. And the environmental issue is as relevant to ecumenism at it is to ecology. It demonstrates clearly the interdependence of the moral and spiritual dimension of man's life with the material and physical. And just as clearly it demands a new synthesis in man's own perception of these two basic dimensions of his own being. Thus, the new ecology must lead to new and larger concepts of ecumenism.

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Gone is the myth that "all things are possible in the best of all possible worlds" that we can have our cake and eat it too. The environmental crisis has demolished the illusion that man can pursue his economic goals without cost to the natural environment on which his own life and well-being ultimately depend and without limiting his opportunities and impairing the quality of his life in social and spiritual terms. But while the illusion has been shattered, the attitudes and practices which accompanied them are so deeply ingrained in the habits and the structures of the highly industrialized societies in particular, that they continue to be the governing force in shaping the life of these societies. And as these are the societies in which most of the world's economic and scientific power reside, their direction affects crucially the fate of the entire world community.

We have to recognize that the structures, the laws and even the values of our societies serve to strengthen and reinforce the status quo – protect the privileges of the few and perpetuate many of the injustices and inequities which afflict the majority. Even where this is not necessarily the intention, it is often the effect of the arrangements we make to conduct our affairs. It is not easy to institutionalize change and even the institutional custodians of such powerful and revolutionary ideas as Christianity become protectors of the status quo and barriers to change.

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The action which governments and peoples have taken to date are still of fairly marginal significance compared to those still before us. We have taken the relatively easy steps – and even these with all too frequent timidity. The difficult choices remain to be made, and they cannot be made solely – or even mainly – by governments. They must rest on the willingness of people to accept as the basis for their relationship with each other new values and new standards of behaviour and responsibility. The action of governments cannot be effective – indeed, will not be possible – without this.

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Surely, the Christian Church must feel a special sense of responsibility and mission as well as a special opportunity from the *very* fact that a large, if not dominant, proportion of the instruments of power in today's world are in the hands of the white Christian world. Peaceful change can only come when those in power are prepared to share it – to subject themselves to constraints and even controls which affect their own immediate interests and patterns of life. But we must believe that peaceful change is possible, though certainly it will be accompanied by political and social turbulence, conflict and difficulties.